Efficient Removal of Heavy Metals from Electroplating Wastewater using Polymer Ligands

Md. Lutfor Rahman , Shaheen M. Sarkar, Mashitah Mohd Yusoff

[a]Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang Kuantan, Malaysia

ABSTRACT

Poly(hydroxamic acid)-poly(amidoxime) chelating ligands were synthesized from poly(methyl acrylate-co-acrylonitrile) grafted acacia cellulose for removing toxic metal ions from industrial wastewaters. These ligands showed higher adsorption capacity to copper (2.80 mmol·g^{-1}) at pH 6. In addition, sorption capacities to other metal ions such as iron, zinc, chromium, and nickel were also found high at pH 6. The metal ions sorption rate ($t_{1/2}$) was very fast. The rate of adsorption of copper, iron, zinc, chromium, nickel, cobalt, cadmium and lead were 4, 5, 7, 5, 5, 8, 9 and 11 min, respectively. Therefore, these ligands have an advantage to the metal ions removal using the column technique. We have successfully investigated the known concentration of metal ions using various parameters, which is essential for designing a fixed bed column with ligands. The wastewater from electroplating plants used in this study, having chromium, zinc, nickel, copper and iron, etc. For chromium wastewater, ICP analysis showed that the Cr removal was 99.8% and other metal ions such as Cu, Ni, Fe, Zn, Cd, Pb, Co and Mn removal were 94.7%, 99.2%, 99.9%, 99.9%, 99.5%, 99.9%, 95.6% and 97.6%, respectively. In case of cyanide wastewater, the metal removal, especially Ni and Zn removal were 96.5 and 95.2% at higher initial concentration. For acid/alkali wastewater, metal ions removing for Cd, Cr and Fe were 99.2%, 99.5% and 99.9%, respectively. Overall, these ligands are useful for metal removal by column method from industrial wastewater especially plating wastewater.

KEYWORDS: heavy metals; adsorption; wastewater; chelating ligands; plating industry

DOI: 10.1007/s11783-015-0783-0